We report on the reversible detection of CaptAvidin, a tyrosine modified avidin, with single-walled carbon nanotube (SWNT) field-effect transistors (FETs) noncovalently functionalized with biotin moieties using 1-pyrenebutyric acid as a linker. Binding affinities at different pH values were quantified, and the sensor’s response at various ionic strengths was analyzed. Furthermore, protein “fingerprints” of NeutrAvidin and streptavidin were obtained by monitoring their adsorption at several pH values. Moreover, gold nanoparticle decorated SWNT FETs were functionalized with biotin using 1-pyrenebutyric acid as a linker for the CNT surface and (+)-α-lipoic acid linkers for the gold surface, and reversible CaptAvidin binding is shown, paving the way for potential dual mode measurements with the addition of surface enhanced Raman spectroscopy (SERS).